A semiconductor device manufacturing method according to a third aspect of the invention comprises: sequentially laminating an insulating layer and a first photoresist on a semiconductor substrate; patterning the first photoresist to form a mask; forming first interconnection grooves by etching the insulating layer with the first photoresist used as a mask; ashing and removing the first photoresist by use of a gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms and nitrogen atoms; burying a carbon layer in the first interconnection grooves; laminating a second photoresist on the insulating layer to cover the carbon layer; patterning the second photoresist to form a mask; forming second interconnection grooves by etching the carbon layer with the second photoresist used as a mask such that each of the second interconnection grooves has a side surface and a bottom surface in the carbon layer; ashing and removing the second photoresist by use of a gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms and nitrogen atoms; depositing a metal interconnection layer in the second interconnection grooves to bury interconnections therein; forming a porous silicon oxide layer on the interlayer insulating layer to cover the interconnections and the carbon layer; and heating the carbon layer to remove the same from the interconnection grooves and provide a hollow around each of the interconnections.--

IN THE CLAIMS:

Please cancel claims 1 – 20 without prejudice or disclaimer of their subject matter, and add new claims 21 – 40 as follows.

21. A dry etching method, comprising:

sequentially laminating a first insulating layer containing carbon and a second insulating layer containing carbon on a substrate;

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patterning the second insulating layer to form a mask;

forming grooves in the first insulating layer by etching the first insulating layer with the second insulating layer used as a mask such that each of the grooves has a side surface and a bottom surface in the first insulating layer; and

removing the second insulating layer by use of a reactive gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms, and nitrogen atoms.

22. The dry etching method according to claim 21, wherein the first insulating layer containing carbon atoms is one selected from the group consisting of a carbon layer, an organic silicon compound layer, and an organic layer.

23. The dry etching method according to claim 21, wherein the second insulating layer containing carbon is a photoresist.

24. The dry etching method according to claim 21, wherein the second insulating layer containing carbon is an organic antireflection layer.

25. The dry etching method according to claim 21, wherein an atomic percentage of carbon is not less than 1/3 of that of oxygen in a gas containing carbon atoms and oxygen atoms among the gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms, and nitrogen atoms.

26. The dry etching method according to claim 25, wherein a gas selected from the group consisting of a gas containing oxygen and carbon dioxide, a gas containing oxygen and carbon monoxide, a carbon monoxide gas, and a carbon dioxide gas, is used as the gas containing oxygen atoms and carbon atoms.

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27. The dry etching method according to claim 21, wherein said removing the second insulating layer includes setting the substrate temperature to not higher than 150°C.

28. The dry etching method according to claim 21, wherein said removing the second insulating layer includes setting the reaction pressure to not higher than 400 m Torr.

29. A semiconductor device manufacturing method, comprising:

sequentially laminating an insulating layer and a photoresist each containing carbon on a semiconductor substrate;

patterning the photoresist to form a mask;

forming interconnection grooves in the insulating layer by etching the insulating layer with the photoresist used as a mask, such that each of the interconnection grooves has a side surface and a bottom surface in the insulating layer;

ashing and removing the photoresist by use of a gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms, and nitrogen atoms; and

depositing a metal interconnection layer in the interconnection grooves to form interconnections therein.

30. The semiconductor device manufacturing method according to claim 29, wherein the insulating layer containing carbon is one of an organic silicon compound layer and an insulating layer of low dielectric constant containing carbon atoms.

31. The semiconductor device manufacturing method according to claim 29, wherein an atomic percentage of carbon is not less than 1/3 of that of oxygen in a gas containing carbon

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atoms and oxygen atoms among the gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms, and nitrogen atoms.

32. The semiconductor device manufacturing method according to claim 29, wherein a gas selected from the group consisting of a gas containing oxygen and carbon dioxide, a gas containing oxygen and carbon monoxide, a carbon monoxide gas, and a carbon dioxide gas, is used as the gas containing oxygen atoms and carbon atoms.

33. The semiconductor device manufacturing method according to claim 29, wherein said removing the second insulating layer includes setting the substrate temperature to not higher than 150°C.

34. The semiconductor device manufacturing method according to claim 29, wherein said removing the second insulating layer includes setting the reaction pressure to not higher than 400 m Torr.

(35) A semiconductor device manufacturing method, comprising:

sequentially laminating an insulating layer and a first photoresist on a semiconductor substrate;

patterning the first photoresist to form a mask;

forming first interconnection grooves by etching the insulating layer with the first photoresist used as a mask;

ashing and removing the first photoresist by use of a gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms, and nitrogen atoms;

burying a carbon layer in the first interconnection grooves;

laminating a second photoresist on the insulating layer to cover the carbon layer;

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patterning the second photoresist to form a mask;

forming second interconnection grooves by etching the carbon layer with the second photoresist used as a mask, such that each of the second interconnection grooves has a side surface and a bottom surface in the carbon layer;

ashing and removing the second photoresist by use of a gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms, and nitrogen atoms;

depositing a metal interconnection layer in the second interconnection grooves to bury interconnections therein;

forming a porous silicon oxide layer on the interlayer insulating layer to cover the interconnections and the carbon layer; and

heating the carbon layer to remove the same from the interconnection grooves and provide a hollow around each of the interconnections.

36. The semiconductor device manufacturing method according to claim 35, wherein at least one of said sequentially laminating an insulating layer and a first photoresist on a semiconductor substrate and said laminating a second photoresist on the insulating layer to cover the carbon layer further includes forming an antireflection layer between the insulating layer and a corresponding one of the first and the second photoresist.

37. The semiconductor device manufacturing method according to claim 35, wherein an atomic percentage of carbon is not less than 1/3 of that of oxygen in a gas containing oxygen atoms and carbon atoms among the gas containing carbon atoms and at least one of oxygen atoms, hydrogen atoms, and nitrogen atoms.

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38. The semiconductor device manufacturing method according to claim 35, wherein a gas selected from the group consisting of a gas containing oxygen and carbon dioxide, a gas